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IRRIGATION IN THE UPPER MISSOURI AND YELLOWSTONE VALLEYS.

IN crossing the great plains over the Union Pacific railroad, through Nebraska and Wyoming, or over the Kansas division through Kansas and Colorado, one is struck not only by the aridity of the country, but also by the fact that no streams of water exist there, adequate, if completely utilized, to irrigate any considerable part of that immense area. One is also struck by the monotony of the physical features, the absence of mountains or hilly areas, as well as of timber. The possibility of settling this vast region seems very remote; and only the discovery of some new and as yet untried method can prevent these plains from constituting, for ages to come, the great natural barrier between the east and the west, — a barrier far more complete than that furnished by the Rocky Mountains themselves.

This condition exists to a greater or less extent as we go southward, though the direction of this belt of uninhabitable country lies somewhat to the west of south. Before I had seen Dakota or Montana, I feared, when reflecting upon these facts, that such a belt might extend northward also, and thus, as it were, actually divide the United States into two sections, marked off from each other by a permanent physical obstruction. This problem seemed to me of the utmost importance, for it is the remote future that must be considered; and if the country has proved capable of so nearly dividing upon an east-and-west line, where there does not exist a single natural feature to render the two sections distinct, what might not be apprehended at some future day, when sectional differences arise between the east and the west, if cut off from each other by an uninhabited desert five hundred miles in width?

It was therefore with special interest that I studied the northern extension of this belt. The fact that the isohyets actually curve eastward, i.e., that the precipitation is less as we go northward on a given meridian, led me to suppose that the difficulties would not diminish. It is certain, however, that the decreased evaporation, due to the reduced temperatures of the more northern parts of the dry belt, much more than compensate for the difference of rainfall. It is, moreover, currently believed by the inhabitants of these more northern districts, that the atmosphere is constantly kept somewhat moist by the influence of the Pacific coast and the Upper Columbia region. A short sojourn on the Upper Missouri and Yellowstone Rivers convinced me of the accuracy

of this view. The general movement of the atmosphere is from west to east. The mountains to the westward are not high, — at least, except at isolated points, — and do not, therefore, suffice to condense all the moisture that passes over them. Near the sources of these streams, as at Bozeman, crops are raised without irrigation, whenever they can withstand the frosts, although the rainfall is there only sixteen inches per annum; and the same is true for eastern Dakota, with no greater precipitation. It is also a matter of record, that the temperature on this latitude diminishes toward the east, and that colder weather prevails in Minnesota than in Dakota, and in Dakota than in Montana. The people attribute this to the occurrence of what they denominate 'Chinook winds;' i.e., winds laden with moisture, and moderated in temperature from the warmer regions of the Pacific slope.

Notwithstanding this, it must still be confessed, that, for all the lower parts of this region of country, — the proper valleys of these rivers, — irrigation is essential to successful agriculture. All statements to the contrary are inspired by interest, usually by the railroad interest, which hopes thereby to increase travel. A number of instances of this came to my notice, one in particular, in which a resident who had published such a statement in a railroad circular was found reaping a field of unfilled oats, six inches high, to be stacked for fodder.

Is this country, then, inhabitable, i.e., capable of sustaining a population? No one will deny that it now possesses advantages for stock-raising; but a country which is only fit for flocks and herds can never have sufficient population to give it importance in a state. A mining region may attract enough inhabitants to become somewhat influential, and will remain so as long as the mines continue to yield. But the only permanent and reliable basis of population is agriculture. It is not necessary, however, that all the land be devoted to agriculture: in fact, it really needs that only a small portion of the soil be actually under the plough to support comfortably a region in which other operations can be carried on in parts not adapted to agriculture. If that portion of the Upper Missouri and Yellowstone valleys which lies between the river and the first general rise or terrace, including the valleys of the numerous *coulées*, or creeks, that flow into it as far as the same level would extend, could be adequately irrigated, this area would furnish an agricultural basis, sufficient, with the great stock-raising region that lies back of it, to

guarantee the ultimate settlement of the country to any required degree of density. I speak of the valleys of these rivers, because it is along these that railroads are either already constructed, or are soon to be constructed; and also, because, whatever may be the case elsewhere, a large part of these valleys far above the flood-line is alluvial in character, and highly fertile.

Now, in comparing this region once more with that of the Upper Platte, whether with the south fork in Colorado, or with the north fork in Wyoming, one great distinguishing fact of the utmost importance presents itself. This fact is, that while, if every drop of the water that flows in the Platte and its tributaries could be turned upon the land, it would only irrigate a small fraction of its own valley, we have in the Missouri and Yellowstone, even in August, a volume of water large enough, if economically applied to this object, to convert the whole of the arable land lying adjacent to them into a rich agricultural region.

Major Powell and his able assistants have carefully calculated the relation of water-supply to irrigable territory; and they come to the conclusion that in Utah a flow of one cubic foot per second will irrigate one hundred acres of land. If this should prove a low estimate for Utah, where evaporation is so rapid that it dries up large rivers almost in their course, it would certainly be ample in the region of Chinook winds.

The volume of water carried by the Upper Missouri and Yellowstone for that part of their course of which we are speaking has not been definitely ascertained. The average annual discharge of the Missouri River at its mouth was determined by Humphreys and Abbott at 120,000 cubic feet per second. A measurement was once taken at the source of the Upper Missouri, i.e., at Three Forks, at a time when the river was found to be four feet below high water, and eight inches above low water, when the volume was found to be 8,541 cubic feet per second. Between these two great extremes we are compelled to estimate for our present purposes. Perhaps 50,000 cubic feet per second would not be an excessive estimate for the volume of the Missouri below the mouth of the Yellowstone; or, assuming, as is claimed, an equal volume for each branch, 25,000 feet each for the two rivers above their junction. The calculation should not be based upon low water, since little use can be made of water in August and September, when the rivers are lowest; while it is in May and June, when the water is still high, that irrigation is chiefly required.

Each of these rivers, could all their water be utilized, would irrigate, at the above estimate, 2,500,000 acres, or nearly 4,000 square miles. This average would hold for points higher up; since the supply of these streams from their tributaries scarcely exceeds the evaporation, and the Missouri is not much larger at Fort Union than at Fort Benton. The distance between these points, by the windings of the river, is 669 miles. If the valley of this river could be irrigated to a width, on an average, of two miles, this would make, at the most, less than 1,400 square miles of surface. This, however, would be reduced in many ways. The smaller curves would be straightened. Much of the way the valley is narrow, and for long stretches, especially in the upper portion, it is reduced to a mere cañon: 1,000 square miles, or 640,000 acres, would be a large estimate for this portion of the Upper Missouri, which certainly would not require more than half of the available water. The same would be true of the Yellowstone; and thus, after thoroughly irrigating their own valleys, these great rivers might, should this be found practicable, furnish large quantities of water, to be conducted from points near their elevated sources to other outlying fertile tracts, which would also become the centres of a wide-spread and thrifty population.

To this scheme, I am aware, many minor objections may be raised, such as the destruction of navigation, about which there would be differences of opinion, but especially respecting the method by which it could be put into practice. This latter question, neglecting all details, we may now briefly consider in its most general aspects.

It is in the nature of things, that the settlers themselves of the districts in question can never carry out this extensive system of irrigation. To be made a practical success, it would require an immense outlay of capital. The few who will go there, knowing that no such system exists, could never afford to inaugurate it. The effect of its not being done must be to prevent its ever being done: therefore, under the ordinary laws of supply and demand, it can never be accomplished; yet no one in this age of great engineering enterprises will deny the physical possibility of such a scheme. Scarcely any one, probably, could be found to question its importance. It must be clear to all, that, if the means of readily irrigating these lands existed, that country would be rapidly filled up by a thriving agricultural population, which would bring after it its customary train of civilizing agencies.

And the political-economist knows that this means increase of national wealth, while the statesman sees in it enhanced national stability and power. Yet, by the natural method on which civilization advances, the conditions to this much-needed settlement can never be secured.

Notwithstanding this, I believe this end will yet be reached. The human race is rapidly outgrowing the natural or genetic method. There is another method, scarcely as yet recognized by the political-economists, but which is being more and more resorted to by enlightened men for overcoming such great physical obstacles to the attainment of clearly-perceived advantages. This is the method of foresight, or calculation. Individuals employ it for the attainment of both private and public ends. Capitalists combine, and lead civilization into regions it would otherwise never have penetrated. It is very probable that a gigantic irrigating company will some time be formed, which will, by degrees, accomplish more or less satisfactorily the desired object. But, in such case, great evils are likely to result,—evils analogous to those that have arisen from permitting great corporations to construct much-needed transcontinental lines of railway. An immense irrigation monopoly would inevitably grow up, which would largely neutralize the benefits derived from the project. Settlement would be impeded by excessive water-rates; and endless litigation, and conflicting legal decisions, would constantly deter population, and jeopardize industry.

A far better plan would undoubtedly be state action. If the territory of Montana possessed the means to undertake such a scheme, it could scarcely fail to prove highly remunerative at the end of a certain period. But here some such an obstacle exists as in the case of mere spontaneous settlement. Not until these tracts are already well-peopled will the territory possess the means of inducing settlement; and we have again a 'vicious circle,' which ends where it begins.

The only unobjectionable plan, as it seems to me, is *national* action. The nation is the largest of all capitalists, and, at the same time, has no tendencies towards monopoly. If we could obtain the same degree of collective foresight in the general government as exists in the average capitalist, nothing could be easier than for the United States, acting as a corporation that seeks only its own interest, not only to secure the particular end of which we are now speaking, but to develop its own resources, and increase its wealth and prosperity in num-

berless other directions, by the ordinary exercise of such foresight.

The present case seems to be one in which the nation has a special interest, rendering it peculiarly fitting that it should extend its aid. It is of the utmost importance as a matter of *national* security, and of immunity from dangers which no statesman can foresee, that the rapidly-growing west, with its peculiar interests, be cemented as speedily and firmly as possible to the east; and nothing can so effectually secure this end as to make the population of the entire Union an unbroken phalanx from the Atlantic to the Pacific.

LESTER F. WARD.

LAWSUITS AGAINST GRUBS AND GRASSHOPPERS.

EVERYBODY knows that migrations of grasshoppers were a hard plague in biblical times, and even before them. Ever since those remote centuries this plague has not ceased to disturb mankind, accompanied or followed by failure of crops, by famine and pestilence. Wherever these hideous guests arrived, the most persistent war has been waged against them, but it has always ended with the defeat of mankind. The consequences were the same as in all other defeats in those remote times. When men were helpless, the intervention of the law or the intervention of God was called upon to interfere, and to stop the ravaging intruders. The reasoning of the people was indeed rational, considering the low state of culture and education. The officers and representatives of the law, as well as the clergy, the natural interpreters between the people and God, were obliged to submit to the wishes of the helpless and therefore unruly people. It is to be supposed that both acted in good faith; nevertheless, we find sometimes indications of a more advanced intelligence, and it is evident that they have then submitted only because resistance was impossible. As such proceedings would have been too ridiculous and useless if not done in a seemingly lawful and imposing form, we find that by and by the development of laws against obnoxious creatures in the middle ages was perfected. A defender was given to the miscreant, as it was deemed lawful that he could not be judged and condemned without being heard and defended. According to the opinion of the old jurists, even to the devil a defender cannot be denied: therefore we find a number of curious law cases reported in those times. In the south of France, a pig which had killed a child was condemned and hanged. Some thieves were hanged, together with their dogs; and the *Lex Carolina* contains a number of paragraphs, not very fit to be repeated, which imposed the sentence of death on animals. Lawsuits against creatures obnoxious to men, and injuring their property, are often reported by the chroniclers, sometimes with a certain kind of